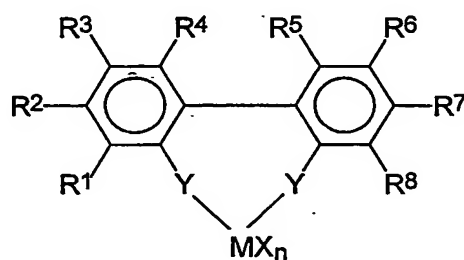


Claims

1. A process for preparing racemic metallocene biphenoxide complexes by reacting transition metal complexes of the formula (I)



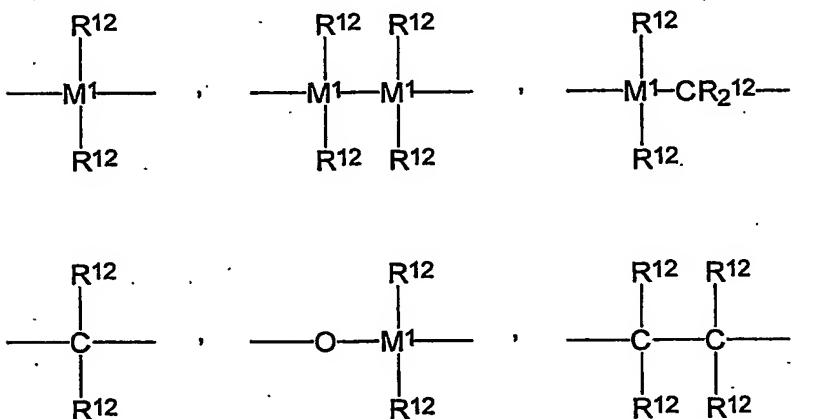
(I),

where the substituents and indices have the following meanings:

- M is titanium, zirconium, hafnium, vanadium, niobium, tantalum, chromium, molybdenum, tungsten or an element of transition group III of the Periodic Table and the lanthanides,
- X are identical or different and are each fluorine, chlorine, bromine, iodine, hydrogen, C₁-C₁₀-alkyl, C₆-C₁₅-aryl, alkylaryl having from 1 to 10 carbon atoms in the alkyl part and from 6 to 20 carbon atoms in the aryl part, -OR⁹ or -NR⁹₂, where R⁹ are identical or different and are each C₁-C₁₀-alkyl, C₆-C₁₅-aryl, C₃-C₁₀-cycloalkyl, alkylaryl,
- n is an integer from 1 to 4 and corresponds to the valence of M minus 2,
- R¹, R², R⁴, R⁵, R⁷, R⁸ are identical or different and are each hydrogen, fluorine, chlorine, bromine, iodine, C₁-C₂₀-alkyl, 3- to 8-membered cycloalkyl which may in turn bear a C₁-C₁₀-alkyl group as substituent, C₆-C₁₅-aryl, alkylaryl having from 1 to 10 carbon atoms in the alkyl part and from 6 to 20 carbon atoms in the aryl part, arylalkyl having from 1 to 10 carbon atoms in the alkyl part and from 6 to 20 carbon atoms in the aryl part, -OR¹⁰, -SR¹⁰, -N(R¹⁰)₂, -P(R¹⁰)₂ or Si(R¹⁰)₃, where R¹⁰ are identical or different and are each C₁-C₁₀-alkyl, C₆-C₁₅-aryl, C₃-C₁₀-cycloalkyl, alkylaryl, where the radicals mentioned may be partially or fully substituted by heteroatoms,

R^3, R^6 are identical or different and are each hydrogen, $-OR^{11}$, $-SR^{11}$, $-N(R^{11})_2$, $-P(R^{11})_2$ or $Si(R^{11})_3$, where R^{11} are identical or different and are each C_1 - C_{10} -alkyl, C_3 - C_{10} -cycloalkyl,

Y are identical or different and are each



$= BR^{12}$, $= AlR^{12}$, $-Ge-$, $-Sn-$, $-O-$, $-S-$, $= SO$, $= SO_2$, $= NR^{12}$, $= CO$, $= PR^{12}$ or $= P(O)R^{12}$,

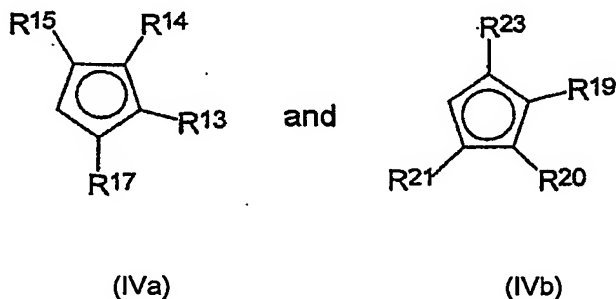
where

R^{12} are identical or different and are each hydrogen, halogen, C_1 - C_{10} -alkyl, C_1 - C_{10} -fluoroalkyl, C_6 - C_{10} -fluoroaryl, C_6 - C_{10} -aryl, C_1 - C_{10} -alkoxy, C_2 - C_{10} -alkenyl, C_7 - C_{40} -arylalkyl, C_8 - C_{40} -arylalkenyl, C_7 - C_{40} -alkylaryl, or two radicals R^{12} together with the atoms connecting them form a ring,

M^1 is silicon, germanium or tin,

with cyclopentadienyl derivatives of alkali metals or alkaline earth metals and heating the reaction mixture obtained in this way to a temperature in the range from -78 to $250^\circ C$.

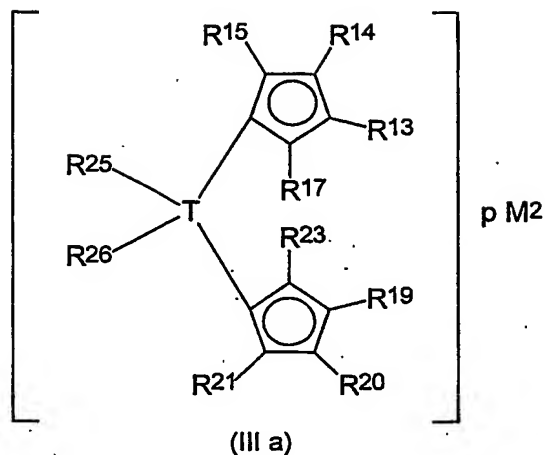
2. A process as claimed in claim 1 comprising the following successive steps:
a) deprotonation of compounds of the formulae (IVa) and (IVb)



by means of a suitable deprotonating agent, where

$R^{13}, R^{14}, R^{15}, R^{17}$ are identical or different and are each hydrogen, C_1 - C_{20} -alkyl, 5- to 7-membered cycloalkyl which may in turn bear a C_1 - C_{10} -alkyl group as substituent, C_6 - C_{15} -aryl or arylalkyl, where adjacent radicals may together form cyclic groups having from 4 to 15 carbon atoms, or $Si(R^{18})_3$, where R^{18} are identical or different and are each C_1 - C_{10} -alkyl, C_6 - C_{15} -aryl or C_3 - C_{10} -cycloalkyl, and $R^{19}, R^{20}, R^{21}, R^{23}$ are identical or different and are each hydrogen, C_1 - C_{20} -alkyl, 5- to 7-membered cycloalkyl which may in turn bear a C_1 - C_{10} -alkyl group as substituent, C_6 - C_{15} -aryl or arylalkyl, where adjacent radicals may together form cyclic groups having from 4 to 15 carbon atoms, or $Si(R^{24})_3$, where R^{24} are identical or different and are each C_1 - C_{10} -alkyl, C_6 - C_{15} -aryl or C_3 - C_{10} -cycloalkyl,

- b) reaction of the deprotonated compounds (IVa) and (IVb) with a compound $[T(R^{25})(R^{26})]_m Hal_2$, where Hal is a halogen substituent such as F, Cl, Br or I, and subsequent repeat deprotonation by means of a suitable deprotonating agent to form a compound of the formula (IIIa)



where

M^2 is an alkali metal ion or alkaline earth metal ion,

where

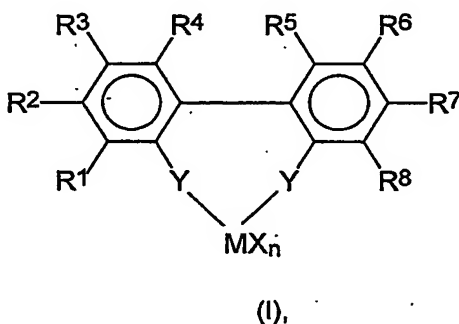
p is 1 when M^2 is an alkaline earth metal ion and is 2 when M^2 is an alkali metal ion, and

T can be identical or different and are each silicon, germanium, tin or carbon,

R^{25}, R^{26} are each hydrogen, C_1 - C_{10} -alkyl, C_3 - C_{10} -cycloalkyl or C_6 - C_{15} -aryl, and

m is 1, 2, 3 or 4;

c) reaction of the compound of the formula (IIIa) with a transition metal complex of the formula (I)



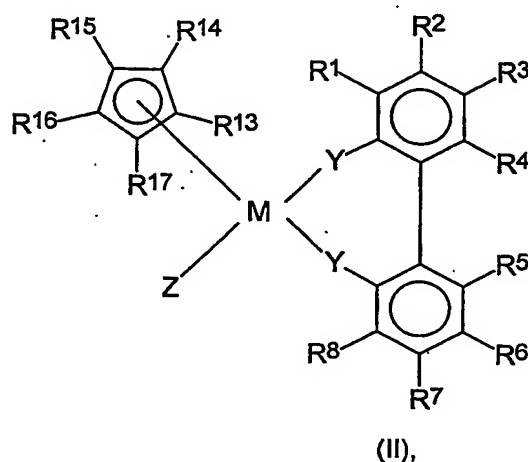
where the substituents and indices are as defined in claim 1.

A process as claimed in claim 2,

wherein the deprotonating agent is selected from among *n*-butyllithium, *tert*-butyllithium, sodium hydride, potassium *tert*-butoxide, Grignard reagents of magnesium, magnesium compounds such as, in particular, di-*n*-butylmagnesium, (*n,s*)-dibutylmagnesium and other suitable alkaline earth metal alkyl and alkali metal alkyl compounds.

4. A process as claimed in claim 2 or 3
which is carried out without isolation of intermediates after individual process steps.
5. A process as claimed in any of claims 2 to 4,
wherein, in the compounds of the formula (IIIa), M^2 is magnesium and R^{17} and R^{23} are each hydrogen or C_1 - C_{10} -alkyl, in particular methyl; ethyl, n-propyl, i-propyl, n-butyl, sec-butyl, tert-butyl, i-butyl, hexyl; or C_6 - C_{10} -aryl, in particular phenyl; or trialkylsilyl, in particular trimethylsilyl, and $T(R^{25}R^{26})$ is bis- C_1 - C_{10} -alkylsilyl or bis- C_6 - C_{10} -arylsilyl, in particular dimethylsilyl, diphenylsilyl, 1,2-ethanediy, methylene; and the radicals R^{13} to R^{15} and R^{19} to R^{21} form, in particular, an indenyl-type ring system or a benzindenyl-type ring system.
6. A process as claimed in any of the preceding claims,
wherein the reaction of the cyclopentadienyl derivatives with compounds of the formula (I) is carried out with addition of free radicals or free radical formers to the reaction mixture.
7. A process as claimed in any of the preceding claims,
wherein R^1 and R^8 in the formula (I) are bulky substituents.
8. A process as claimed in any of the preceding claims,
wherein R^3 and R^6 in the formula (I) are each methoxy, ethoxy, isopropoxy, tert-butoxy, cyclopropyloxy or cyclohexyloxy.
9. A process as claimed in any of the preceding claims,
wherein the bridging units Y in the formula (I) are identical and are each oxygen.
10. A process as claimed in any of the preceding claims,
wherein cyclopentadienyl derivatives of magnesium or lithium are used.

11. A racemic metallocene biphenoxide complex of the formula (II)

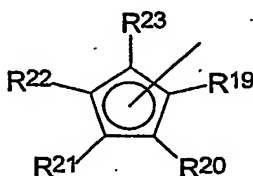


where Y, M and R¹ to R⁸ are as defined in claim 1, and

R¹³ to R¹⁷ are identical or different and are each hydrogen, C₁-C₂₀-alkyl, 5- to 7-membered cycloalkyl which may in turn bear a C₁-C₁₀-alkyl group as substituent, C₆-C₁₅-aryl or arylalkyl, where adjacent radicals may together form cyclic groups having from 4 to 15 carbon atoms, or Si(R¹⁸)₃, where

R¹⁸ are identical or different and are each C₁-C₁₀-alkyl, C₆-C₁₅-aryl or C₃-C₁₀-cycloalkyl, and

Z is



where the radicals

R¹⁹ to R²³ are identical or different and are each hydrogen, C₁-C₂₀-alkyl, 5- to 7-membered cycloalkyl which may in turn bear a C₁-C₁₀-alkyl group as substituent, C₆-C₁₅-aryl or arylalkyl, where adjacent radicals may together form cyclic groups having from 4 to 15 carbon atoms, or Si(R²⁴)₃ where

R^{24} are identical or different and are each C_1 - C_{10} -alkyl, C_6 - C_{15} -aryl or C_3 - C_{10} -cycloalkyl,

or the radicals

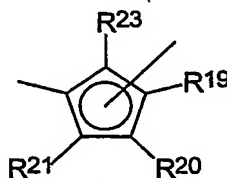
R^{16} and Z together form a $-[T(R^{25})(R^{26})]_m-E-$ group, where

T may be identical or different and are each silicon, germanium, tin or carbon,

R^{25} , R^{26} are each hydrogen, C_1 - C_{10} -alkyl, C_3 - C_{10} -cycloalkyl or C_6 - C_{15} -aryl

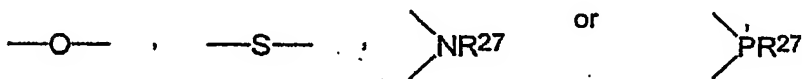
m is 1, 2, 3 or 4, and

E is



or A, where

A is



where R^{27} are identical or different and are each C_1 - C_{10} -alkyl, C_6 - C_{15} -aryl, C_3 - C_{10} -cycloalkyl, alkylaryl or $Si(R^{28})_3$

where R^{28} are identical or different and are each C_1 - C_{10} -alkyl, C_6 - C_{15} -aryl, C_3 - C_{10} -cycloalkyl or alkylaryl.

12. A racemic metallocene biphenoxide complex as claimed in claim 11 in which R^{17} and R^{23} are not hydrogen when R^{16} and Z together form a $-[T(R^{25})(R^{26})]_m-E-$ group.
13. The use of a racemic metallocene biphenoxide complex as claimed in claim 11 or 12 as a catalyst or as a constituent of a catalyst for the polymerization of olefinically unsaturated compounds or as a reagent or catalyst in stereoselective synthesis.